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Blister Packaging Machine

The invention concerns a blister packaging machine comprising a filling station for inserting products into cup-shaped depressions of a bottom sheet, and a downstream sealing station in which a supplied cover sheet can be sealed onto the bottom sheet thereby forming a blister band, wherein the sealing station is operated in cycles and has an associated first driving device which is also operated in cycles, and with which the bottom sheet and the cover sheet can be discontinuously transported through the sealing station.

A blister packaging machine of conventional structure comprises a forming station, in which a plurality of cup-shaped depressions are formed into a bottom sheet which consists e.g. of plastic material or aluminium, into which a product, e.g. a pharmaceutical tablet, is inserted in a downstream filling station. After product supply, the bottom sheet is passed to a sealing station. A cover sheet is fed directly before or within the sealing station and disposed on the bottom sheet on the open side of the cup-shaped depressions. The cover sheet is tightly sealed onto the bottom sheet in the sealing station using heat and pressure thereby enclosing the products in the cup-shaped depressions.

To ensure precise supply and disposal of the products in the cup-shaped depressions of the bottom sheet, the filling station is preferably stationary or fixed and the bottom sheet is uniformly guided at a constant speed through the filling station. The cover sheet is thereby continuously sealed in the downstream sealing station, conventionally using a rotating sealing roller which can be controlled to a predetermined desired temperature using a heating device. The bottom sheet is

transported together with the cover sheet at a constant transport speed through the sealing station, i.e. through the gap between the sealing roller and the opposite roller, thereby transmitting heat from the sealing roller to the sheets, thereby connecting them. The heat transmission between the sealing roller and the sheets depends on their transport speed. At high transport speeds, the contact time between the sealing roller and the sheets is relatively short and only a small amount of heat can be introduced into the sheets. If the heat introduced into the sheets is insufficient, the sealing may be incomplete and the bottom sheet and the cover sheet may not be tightly sealed. With a slow transport speed, the contact time between the sealing roller and the sheets is relatively long, and a large amount of heat is introduced into the sheets. The cover sheet, which is quite sensitive to heat, can thereby be damaged. A reliable sealing between the bottom sheet and the cover sheet is not ensured.

For the above-mentioned reasons, many users prefer having sealing stations with cyclic operation of closing and opening sealing plates, wherein the heat transmission to the sheets and thereby the sealing process can be set with great accuracy via the closing times of the sealing plates to produce a very smooth overall sealing appearance. In a conventional sealing station with cyclic operation, the blister band, i.e. the bottom sheet with inserted products and sealed cover sheet is grasped by a drive device in cyclic operation, which is disposed behind the sealing station, e.g. in the form of tongs and advanced by a predetermined amount. The tongs open subsequently and are moved against the transport direction along the blister band to grasp the blister band again in an upstream section. This produces continuous alteration between transport motion and standstill of the blister band. The bottom sheet is also intermittently moved such that it is transported in cycles through the filling station. It has turned out, however, that cyclic

operation of the filling station causes frequent disturbances. For this reason, many users prefer a continuously operating filling station.

To be able to meet the contradicting requirements of a continuously operating filling station and a sealing station which is operated in cycles, filling stations have been designed which can be displaced along the bottom sheet. The filling station is thereby adjusted relative to the bottom sheet with the bottom sheet at rest. It has, however, turned out that these proceedings require demanding structures and are therefore expensive. Moreover, the adjustable filling station is highly susceptible to malfunction and immensely limits the efficiency of the blister packaging machine.

It is the underlying purpose of the invention to provide a blister packaging machine of the above-mentioned type with a sealing station which is operated in cycles and reliably permits use of an efficient filling station.

This object is achieved with a blister packaging machine of the above-mentioned type having the characterizing features of claim 1. A second drive device for the bottom sheet is thereby disposed between the filling station and the sealing station for discontinuously transporting the bottom sheet, wherein the drive motions of the first drive device and the second drive device are superposed such that the bottom sheet is transported through the stationary filling station with a constant speed.

The invention is based on the fundamental consideration of supplementing the cyclic or intermittent advance motion of the bottom sheet due to the first drive device of the sealing station, which is operated in cycles, with a second drive device which acts on the bottom sheet between the filling station and the sealing station, preferably

upstream of the supply of the cover sheet to thereby provide a discontinuous and controlled transport motion of the bottom sheet. The two drive motions of the first drive device and the second drive device are matched to each other such that the resulting motion of the bottom sheet in the filling station is a continuous advance motion at constant transport speed. This permits continuous filling of the products into the cup-shaped depressions using a conventional fixed filling station along with cyclic or discontinuous sealing.

The second drive device acts in particular on the bottom sheet when the first drive device does not move the bottom sheet during sealing. As soon as the sealing plates open, the first drive device pulls the blister band and also the bottom sheet further, thereby compensating for at least the length of the bottom sheet which was advanced by the second drive device during sealing.

In a preferred embodiment of the invention, the second drive device comprises a deflecting device which can be adjusted between a basic position and a deflected position, wherein during adjustment, a tensile force is exerted onto the bottom sheet located at the filling station. The bottom sheet is looped around the deflecting device. During adjustment of the deflecting device, the size of the loop of the bottom sheet increases. The deflecting device is thereby preferably adjusted perpendicularly to the main transport direction of the bottom sheet. Since the deflecting device is adjusted when the sealing station is closed and the bottom sheet is thereby clamped and held at this location, i.e. downstream of the deflecting device, adjustment of the deflecting device from the basic position to the deflected position advances the bottom sheet on the side of the deflecting device facing the filling station.

The deflecting device may, in particular, be returned from the deflected position into the basic position. Returning the deflecting device into the basic position reduces the size of the loop in the bottom sheet, and the released bottom sheet length is compensated for by the first drive device of the sealing station during cyclic operation thereof. The motions are thereby matched such that the bottom sheet is transported through the filling station at a constant speed.

The deflecting device may comprise a deflecting roller which can be adjusted perpendicularly to its longitudinal extension. However, this is problematic in practice since the cup-shaped depressions of the bottom sheet are supported on the outer surface of the deflecting roller. For this reason, in a preferred embodiment of the invention, the deflecting device comprises a shaft which can be adjusted by a motor and on which several separated relatively thin deflecting discs are disposed. The mutual separation between the deflecting discs is such that they are disposed exactly between two cup-shaped depressions of the bottom sheet, with the cup-shaped depressions hanging between the deflecting discs within the deflecting device.

To adjust the deflecting device to different blister dimensions and thereby differently disposed cup-shaped depressions, a further development of the invention provides that the mutual separation between the deflecting discs along the shaft can be changed.

Frictional forces may be produced by pulling the bottom sheet through the deflecting device and thereby over the deflecting discs using the first drive device of the sealing station. They can be reduced when the deflecting discs are rotatably disposed on the shaft in a further development of the invention.

In a blister packaging machine, the bottom sheet is generally oriented such that the cup-shaped depressions open towards the top and the products are inserted into the cup-shaped depressions from above. When the bottom sheet with inserted products is deflected in the deflecting device in loops, preferably upward, individual products may fall out of the cup-shaped depressions. To reliably prevent this, the deflecting device of a further development comprises several guiding elements and in particular guiding walls, on which the bottom sheet is supported with the open side of the cup-shaped depressions. When the bottom sheet passes in loops through the deflecting device, the cup-shaped depressions are covered thereby reliably preventing the products from falling out.

Further details and features of the invention can be extracted from the following description of an embodiment with reference to the drawing.

Fig. 1 shows a schematic illustration of some stations of a blister packaging machine in accordance with the invention;

Fig. 2 shows some stations of the blister packaging machine in an initial state of a cycle;

Fig. 3 shows the stations of Fig. 2 in a first intermediate state of the cycle;

Fig. 4 shows the stations of Fig. 2 in a second intermediate state of the cycle;

Fig. 5 shows the stations of Fig. 2 in a final state of the cycle;

Fig. 6a shows a path-time diagram which shows the (theoretical) motion of the bottom sheet in the region of the filling station due only to the first drive device;

Fig. 6b shows a path-time diagram which shows the (theoretical) motion of the bottom sheet in the region of the filling station due only to the second drive device;

Fig. 6c shows a path-time diagram which shows the (theoretical) motion of the bottom sheet in the region of the filling station due to the first and second drive devices combined;

Fig. 7 shows a perspective view of the deflecting device;

Fig. 8 shows a perspective lower view of the deflecting device; and

Fig. 9 shows a perspective rear view of the deflecting device.

Fig. 1 schematically shows some stations of a blister packaging machine 10 which are subsequently passed by a bottom sheet 11 in which a plurality of cup-shaped depressions 12 are conventionally formed in a forming station (not shown). The main transport direction of the bottom sheet 11 is indicated by arrow H. The bottom sheet 11 initially passes through a stationary filling station 13 in which a product 14, e.g. a pharmaceutical tablet, is inserted from above into the cup-shaped depressions 12 of the bottom sheet 11. The horizontal bottom sheet 11 reaches a deflecting device 20 in which the bottom sheet 11 is deflected in an upwardly directed wavy loop, and is subsequently returned into the horizontal orientation. The deflecting device 20 can be vertically height-adjusted as is indicated by the double arrow A and constitutes a second drive device 15 for the bottom sheet 11.

A cover sheet 16 is supplied to the bottom sheet downstream of the deflecting device 20 and directly before a sealing station 18, and is disposed onto the upper side of the bottom sheet 11 via a deflecting roller 17. The sealing station 18 comprises sealing plates 18a and 18b which can be vertically opened and closed, as is indicated by arrow C. The sealing plates 18a and 18b are heated and seal the cover sheet 16 onto the bottom sheet 11 thereby sealing the cup-shaped depressions 12 of the bottom sheet 11.

A first drive device 19 for the blister band 30 formed by the bottom sheet 11, the inserted products 14 and the cover sheet 16, is disposed downstream of the sealing station 18 i.e. in the main transport direction 11, behind the sealing station 18. The first drive device 19 comprises a gripper or tongs 19a for grasping the blister band 30. The tongs 19a can be moved by a motor along a linear guidance 19b which extends parallel to the main transport direction H of the blister band 30, between an initial position facing the sealing station 18 and an end position (shown in Fig. 1 in broken lines) and back to the initial position, as is indicated by the double arrow B in Fig. 1. The tongs 19a grasp the blister band 30 in the initial position and are moved to the end position thereby pulling the blister band 30 forward in the main transport direction H. In the end position, the tongs 19a release the blister band 30 and return to the initial position. In this fashion, an intermittent or cyclic advance motion is transferred to the blister band 30 and thereby also to the bottom sheet 11.

While the first drive device 19 transports the blister band 30 and the bottom sheet 11, the sealing device 18 is opened by moving the sealing plates 18a and 18b apart. As soon as the advance motion of the blister band 30 caused by the first drive device 19 is terminated, the sealing

plates 18a and 18b are closed thereby sealing the cover sheet 16 onto the bottom sheet 11 in the section located within the sealing station 18. During this time, the tongs 19a return into their initial position and the bottom sheet 11 cannot be transported by the first drive device 19. A path-time diagram which shows the theoretical motion of the bottom sheet 11 in the region of the filling station 13 due to the first drive device 19 alone is shown in Fig. 6a. At a time t_0, the first drive device 19 releases the blister band 30 and returns into its initial position during a time period T_1 after which the tongs 19a again grasp the blister band 30. During this time period T_1, the blister band 30 and the bottom sheet 11 are not moved by the first drive device 19. As soon as the sealing station 18 opens, the blister band 30 as well as the bottom sheet 11 are pulled forward at a time t_1 through displacement of the tongs 19a of the first drive device 19 along the linear guidance 19b until the end position has been reached at a time t_2. The blister band 30 and the bottom sheet 11 thereby have moved through a path s_2. The sealing device 18 closes again for a subsequent time period T_3 which corresponds to the time period T_1, resulting in a standstill of the blister band 30 and therefore of the bottom sheet 11 with respect to the first drive device 19.

The first drive device 19 alone would produce a discontinuous, cycled transport motion of the bottom sheet 11 in the region of the filling station 13, which is undesired. For this reason, a second drive device 15, in the form of the deflecting device 20, is provided between the filling station 13 and the sealing station 18 and causes an additional motion of the bottom sheet 11 in the region of the filling station 13. The drive motions of the first drive device 19 and of the second drive device 15 are thereby superposed such that the bottom sheet 11 is transported through the filling station 13 at a constant speed.

The deflecting device 20 comprises a horizontal shaft 21 which extends substantially perpendicularly to the main transport direction H, and on which three deflecting discs 22 are rotatably disposed at mutual axial separations. The separation between the deflecting discs 22 relative to each other can be changed to ensure that the cup-shaped depressions 12 of the bottom sheet 11 pass between the deflecting discs 22. The shaft 21 penetrates a rear wall 28 on a vertical elongated hole 27 and is connected via a transmission 26 to a servomotor 25 mounted to a holding plate 31 on the rear wall 28 side facing away from the deflecting discs 22. The deflecting discs 22 are covered by a cover 24 forming a guiding element, leaving only a narrow gap on their upper side. The shaft 21 is moreover connected to a guiding block 29 which is displaceably disposed in a guiding groove 32 of the basic plate 28. The shaft 21, the deflecting discs 22 disposed thereon, the cover 24 and the guiding block 29 can be moved vertically up and down via the servomotor 25, wherein guidance is ensured through engagement of the guiding block 29 in the guiding groove 32.

Convexly curved guiding plates 23 are disposed on the side of the deflecting discs 22, and are mounted to the base plate 28 and do not follow the vertical up and down motion of the shaft 21 or the deflecting discs 22.

As is shown in Fig. 2, the bottom sheet 11 passes from the filling station through the deflecting device 20 thereby forming a loop which extends vertically upward. The bottom sheet 11 reaches the deflecting device 20 passing in a horizontal direction from the filling station (left in Fig. 2), wherein the cup-shaped depressions 12 containing one product each 14 and are open towards the top. The bottom sheet 11 moves below the associated guiding plate 23 which covers the cup-shaped depressions 12 thereby preventing the products 14 from falling out. The bottom sheet 11

is vertically upwardly deflected by 90° and passes through the gap between the deflecting discs 22 and the cover 24, and is deflected vertically downward by 180°, thereby forming the loop. The cover 24 prevents the products 14 from falling out of the cup-shaped depressions 12 in this region. The bottom sheet 11 is subsequently deflected again by 90° and returned into its original horizontal orientation, wherein the further guiding plate 23 in this region prevents the products 14 from falling out. The bottom sheet 11 reaches the sealing station 18 with this orientation..

While the sealing station 18 is closed, the shaft 21 is displaced with the deflecting discs 22 from a lower initial position in accordance with Fig. 2 into an upper end position in accordance with Fig. 3. A tensile force is thereby exerted onto the bottom sheet 11. Since the bottom sheet 11 is clamped in the sealing station 18, the tensile force exerted by the deflecting device 20 onto the bottom sheet 11 produces a transport motion of the bottom sheet 11 in the region of the filling station 13. As is shown in the path time diagram in Fig. 6b, this transport motion is transferred to the bottom sheet 11 in the time period T_1, i.e. while the sealing station 18 is closed. As soon as the blister band 30 and therefore the bottom sheet 11 are transported again by the first drive device 19 in a time period T_2, the deflecting device 20 returns to its lower initial position. Excess bottom sheet 11 is released which is shown as returning transport motion in the diagram of Fig. 6b in the time period T_2. However, this return transport motion produces no motion of the bottom sheet 11 against the main transport direction H, since this excess bottom sheet 11 is taken up by the transport speed of the first drive device 19, which is greater than the bottom sheet release rate in the time period T_2 during which the compensating device 20 returns, such that an overall transport motion in the main transport direction H remains for the bottom sheet 11 in the region of the filling station 13.

As is shown in the path time diagram of Fig. 6c, the motions of the first drive device 19 and the second drive device 15 with the deflecting device 20 are matched and synchronized such that a continuous transport motion of constant speed is obtained for the bottom sheet 11 in the region of the filling station 13. It is dictated for time period T_1 by the second drive device 15 only and, for the time period T_2, through superposed drive motions of the drive devices 19 and 15.

A cycle of the sealing station 18 and the first drive device 19 including the drive through the second drive device 15 are explained below with reference to Figs. 2 through 5.

In accordance with Fig. 2, the tongs 19a are located at time t_0 in their end position and the deflecting device 20 is in its lower initial position. The sealing station closes (arrow S) and the bottom sheet 11 is clamped. During time period T_1, the tongs 19a of the first drive device 19 move back into their initial position (arrow R) and the deflecting device 20 is moved vertically upwards (arrow V_1) thereby exerting a transport motion at constant speed onto the bottom sheet 11 in the region of the filling station. At the time t_1, which is shown in Fig. 3, the deflecting device 20 has reached its upper end position while the tongs 19a of the first drive device 19 have assumed their initial position proximate the sealing station 18 and have grasped the blister band 30. The sealing station 18 opens (arrow O) and the first drive device 19 pulls the blister band 30 and thereby also the bottom sheet 11 in the main transport direction H as indicated by arrow Z. At the same time, the deflecting device 20 moves downwards (arrow V_2). With the first drive device 19 and the deflecting device 20 moving at different speeds, the bottom sheet 11 has a resulting transport motion in the region of the filling station of constant

speed, which corresponds to the speed during time period T_1, i.e. as generated by the second drive device 15 only.

Fig. 4 shows an intermediate position of the motions during time period T_2, wherein the tongs 19a of the first drive device 19 are still moving forward (arrow Z) and the deflecting device 20 is being lowered (arrow V_2).

Fig. 5 shows the cycle end at the time t_2 at the end of the time period T_2. The tongs 19a of the first drive device 19 have reached their final position and the deflecting device 20 is in its lower initial position. At time t_2 (Fig. 5), a new cycle starts such that the individual stations and components are at the same position as at time t_0 (Fig. 2) and the cycle starts again from the beginning as described above.